

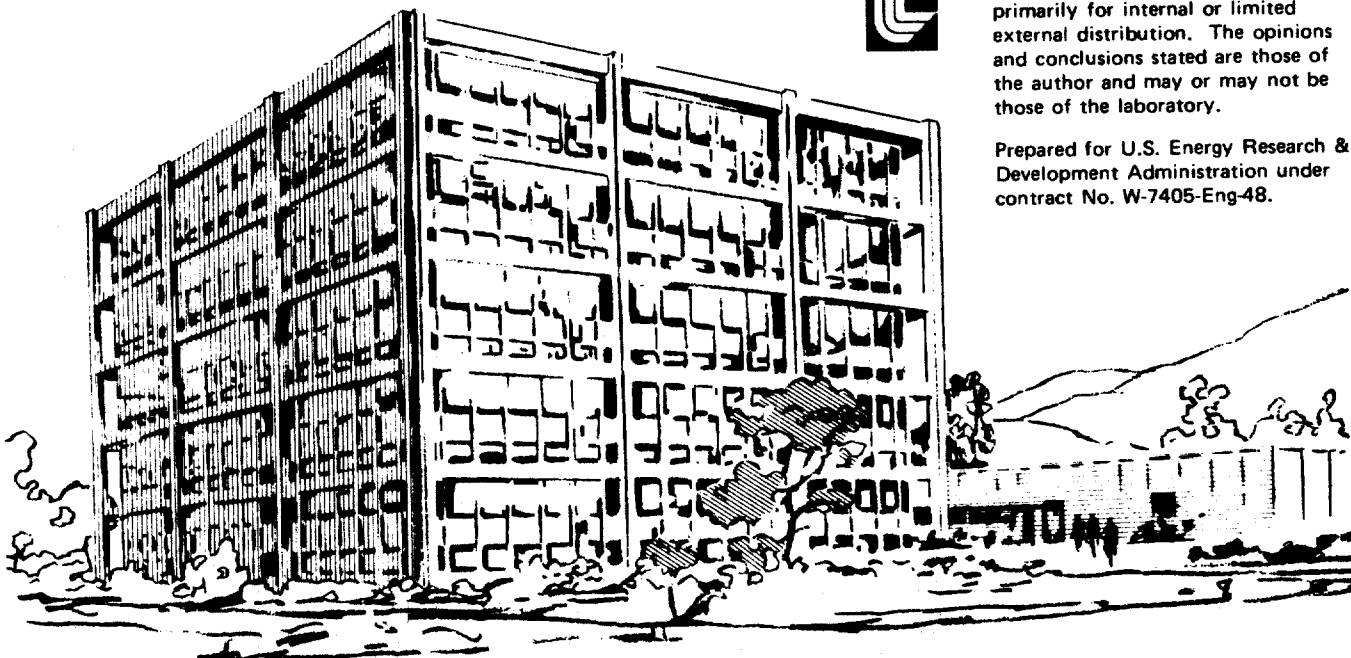
Lawrence Livermore Laboratory

A SURVEY OF CONTAINED HIGH EXPLOSIVE FIRING FACILITIES

R. S. Lee, H. C. Vantine and R. C. Weingart

November 21, 1978

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A SURVEY OF CONTAINED HIGH EXPLOSIVE FIRING FACILITIES

R. S. Lee, H. C. Vantine and R. C. Weingart

Lawrence Livermore Laboratory

October 11, 1978

A B S T R A C T

A survey has been made of the facilities available for the enclosed firing of high explosive (HE) experiments at a number of laboratories engaged in HE research and development. The purpose of the survey was to assist in the planning of the long range High Explosives Research and Development Facilities at the Lawrence Livermore Laboratory. Results of the survey are summarized and the completed questionnaires are reproduced in the Appendix.

INTRODUCTION

Experiments carried out on small HE charges fired in enclosed chambers at the Lawrence Livermore Laboratory have proven to be very effective, from both an economic and a scientific viewpoint. For example, during 1976 approximately two thousand experiments were conducted in our enclosed firing facilities, and were accomplished with much less manpower and cost than would have been required at a remote site open firing bunker. The laboratory environment provides flexibility in diagnostic capability and the on-site location of the enclosed chambers enables our experimenters to maintain close scrutiny of both the shot assemblies and the experiments without losing touch with the mainstream activities at the Laboratory.

In planning for our future needs we wished to consider enclosed firing chambers which would not only accommodate today requirements, but would provide enough flexibility to enable us to perform state-of-the-art laboratory experiments into the foreseeable future. We felt that a survey of existing enclosed firing facilities and procedures at other HE research and development laboratories would be helpful in this planning. Our survey was addressed to selected major organizations who participated in the Sixth Detonation Symposium (International) held in San Diego, California, in August, 1976. A list of survey respondents is presented in Table 1.

The maximum HE weight limit we can expend at any of the enclosed firing facilities at Lawrence Livermore Laboratory is presently 0.35 kg (PBX-9404 equivalent). We feel that an important addition to our enclosed firing facilities would be the capability of firing multi-kilogram HE charges to do meaningful studies on insensitive explosives (e.g. TATB) where the charge weight required to observe the development of a steady detonation wave is an order of magnitude larger than for a conventional, HMX-based explosive subjected to similar stimuli. Even for the HMX-based explosives, the buildup to detonation from low-intensity accidental stimuli may occur over many centimeters of run, further emphasizing the need for increased firing chamber weight limits. Our main purpose in the survey was to identify laboratories which are successfully operating multi-kg facilities on-site in close proximity to populated areas, as we propose to do in the future.

Response to our survey was excellent. Many major research and development organizations operate enclosed firing chambers in laboratory areas as standard practice and have done so for many years. The successful experience of these organizations has motivated our proposal for a similar on-site firing capability at the Livermore Laboratory Site.

RESULTS OF SURVEY

We felt that the survey would best be served by a questionnaire which asked for open-end responses rather than for detailed information which might not apply to a particular facility. The questionnaire is listed in the Appendix along with the responses from those who participated. The survey, which was begun in March 1977, was taken over a period of one year. Some of the participants may have added new capabilities to their HE operations since their response to our questionnaire.

The results of our survey can be expressed in several ways. We chose to look in some detail at the distributions of HE firing weight limits at the various facilities and their proximity to off-site populated areas. We were also interested in the type of firing structures in use as well as the constraints which limited the quantity of HE expended.

Figure 1 shows the distribution of HE weight limits at the various facilities. We listed only the firing chambers with weight limits in excess of 200 gm. Of the 35 chambers listed, 50% had weight limits less than 2 kg. Only 20% had weight limits of 10 kg or more. Our chambers at LLL fall in the lower part of the distribution. A small grouping occurs around .5 kg; firing facilities appear to be equally distributed in number between the 1.0 to 25.0 kg weight limit range.

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The second area in which we summarized the questionnaire response was in the proximity of HE research facilities to populated areas. We were particularly interested in identifying facilities with weight limits in the multi-kg range which were operated in proximity to populated on-site as well as off-site areas. (Several survey respondents were contacted to clarify questionnaire answers). Figure 2 is a scatter diagram of HE weight limits versus proximity to off-site populated areas for the facilities surveyed. Multiple facilities at the same location are often listed only once. It can be seen that a number of facilities operate close to off-site populated areas. The survey sheets and further discussion with the organization reveal that the proximity of the firing chambers to on-site population is much smaller, in some instances tens of meters.

Most of the firing chambers were either reinforced concrete or steel vessels. About half of the firing chambers were reinforced concrete, in many instances a concrete structure lined with steel plate. The remaining structures were steel vessels. It is interesting to note that with one exception, respondents to the survey listed only chamber structural design and noise as the factors limiting the quantity of HE expended (and not HE handling, transportation, etc).

For details not listed on the summary sheets we refer the reader to the contact, listed on the survey sheet.

CONCLUSIONS

Most of the HE research and development laboratories which responded to the survey had some type of enclosed firing facilities. Our conclusions can be broken down into three areas. First, enclosed firing chambers for multi-kg quantities of HE are fairly common. Secondly, on-site location and the proximity of these facilities to populated non-HE areas is not unusual. Finally, satisfactory designs for multi-kg HE chambers exist and have proven satisfactory.

We believe that the number and variety of these facilities indicates a broad agreement on the value and practicality of enclosed firing facilities within the HE community.

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TABLE I
Respondents to Survey with Contained Firing Facilities

<u>Laboratory/Organization</u>	<u>Abbreviation</u>	<u>Firing Facility Location</u>
Atomic Weapons Research Establishment	AWRE	Aldermaston, England
Air Force Armaments Testing Laboratory	AFATL	Eglin AFB, Florida
Battelle Columbus Laboratories (1)	BCL	Columbus, Ohio
E.I. du Pont	dP	Martinsburg, W. VA
Harry Diamond Laboratories	HDL	Alelphi, MD
Honeywell, Incorporated	HI	Elk River, MINN
Lawrence Livermore Laboratory	LLL	Livermore, CA
Los Alamos Scientific Laboratory	LASL	Los Alamos, NM
Monsanto Research Corp. (Mound Lab)	ML	Miamisburg, Ohio
Naval Surface Weapons Center	NSWC	White Oak, MD
Sandia Laboratories	SLA	Albuquerque, NM
Sandia Laboratories	SLL	Livermore, CA
Shock Hydrodynamics	SH	Newhall, CA
Stanford Research Institute	SRI	Menlo Park, CA
Systems Science and Software	S ³	La Jolla, CA
Teledyne McCormich Selph	TMS	Hollister, CA
U.S. Army Ballistic Research Laboratory	BRL	Aberdeen, MD
U.S. Bureau of Mines	BM	Pittsburgh, PA

Respondents without Contained Firing Facilities

Hercules, Incorporated	--	No Contained-Explo. Fac.
IIT Research Institute	--	No Contained-Explo. Fac.
Naval Weapons Station	--	No Contained-Explo. Fac.
U.S. Air Force Academy	--	No Contained-Explo. Fac.

NOTE: (1) Did not respond to survey. Data on enclosed facilities were obtained from Proceedings of 12th Annual Symposium on Behavior and Utilization of Explosives in Engineering Design, University of New Mexico, March 1972, pp. 167-173.

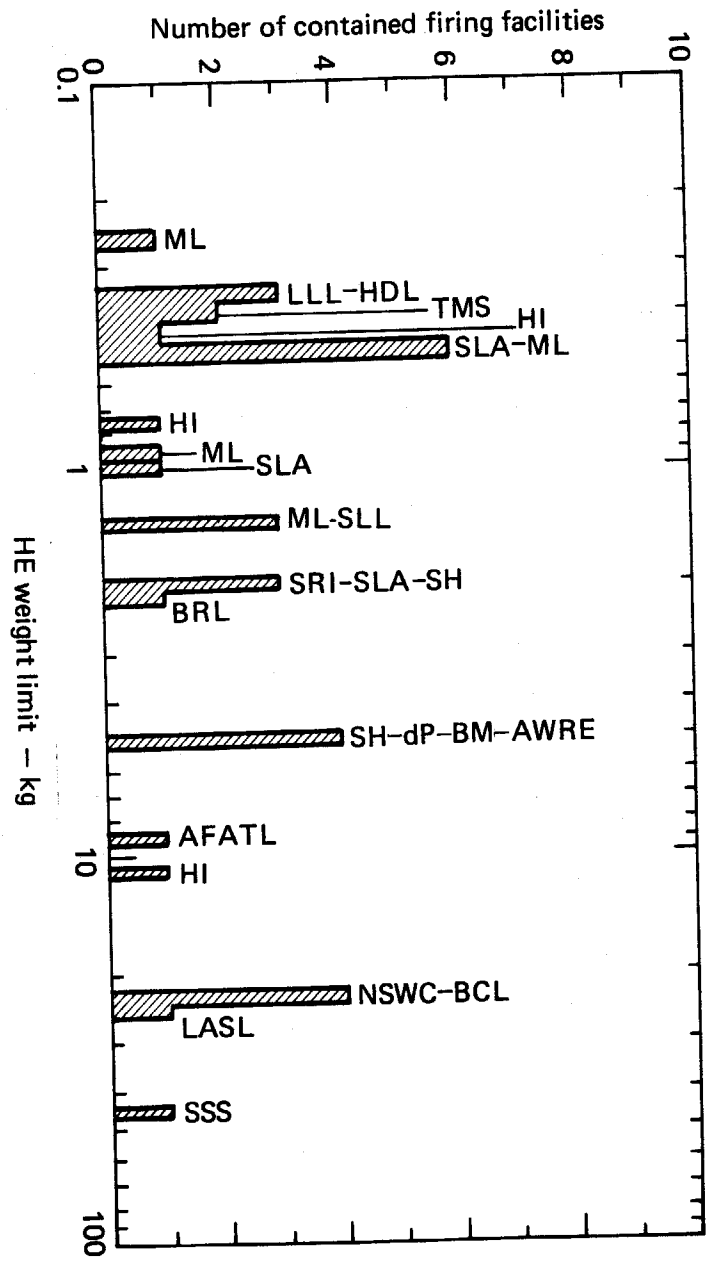


Figure 1

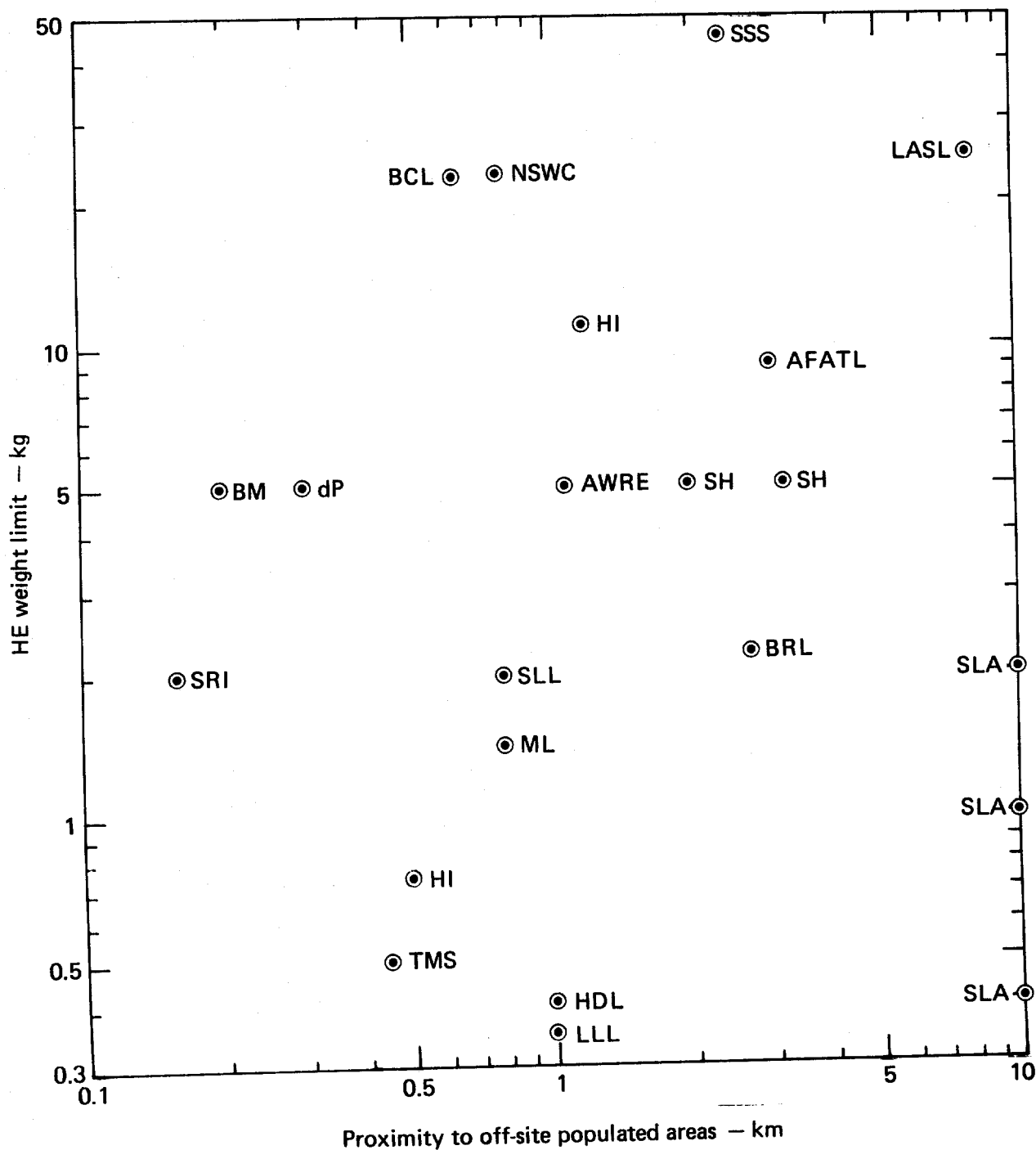


Figure 2

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APPENDIX

CONTAINED EXPLOSIVE FIRING FACILITIES- QUESTIONNAIRE -Organization AFATL/DLDEContact James C JonesTelephone 904-882-3441(1) Facility Location-Proximity to Occupied Areas Eglin AFB, Florida, HERD Facility(2) Purpose High Explosives Research and Development(3) Test Explosive Weight Limit (Equivalent Kg of TNT) 20 lbs TNT (9.072 Kg)(4) Principal Constraints on Explosive Weight Limit None(5) Type of Firing Chamber Construction (e.g., reinforced concrete) Reinforced concrete with one-inch inner steel plate.(6) Diagnostics in Use High speed photography: Md75 steak camera, 3 ea. framing cameras, photosonic 16mm and Hxcam; electronics: L10 Raster oscilloscopes, R-7404 TEK scopes, 519 fast rise scopes, counters, etc.(7) Other Comments Facility consists of an explosive properties lab, explosives processing facility and a hydrodynamic test facility.

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CONTAINED EXPLOSIVE FIRING FACILITIES- QUESTIONNAIRE -

Organization U.S. Army Ballistic Research Lab.
 Contact R. Frey
 Telephone 301-278-2653

- (1) Facility Location-Proximity to Occupied Areas Located in the midst of
a laboratory-office complex. Military housing is located about 1/4 mile away.
Civilian (off post) housing is at least three miles away
- (2) Purpose Vulnerability and performance studies on HE charges
- (3) Test Explosive Weight Limit (Equivalent Kg of TNT) 2.2 kg
- (4) Principal Constraints on Explosive Weight Limit These chambers were designed
over 20 years ago and the original reasons for the weight limits seem to be lost.
At present, we believe the parts and the bolts which fasten the armor lining to the
concrete are weak links
- (5) Type of Firing Chamber Construction (e.g., reinforced concrete) _____
Reinforced concrete lined with armor plates.
- (6) Diagnostics in Use Streak camera (to 16 mm/usec), framing camera (to 1.2×10^6 frames/s)
flash X-ray, piezoelectric and piezoresistive pressure gages.
- (7) Other Comments BRL has two identical chambers of the type described. We also have
other special purpose chambers with smaller weight limits.

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CONTAINED EXPLOSIVE FIRING FACILITIES

- QUESTIONNAIRE -

Organization A.W.R.E.
Contact B D Lambourn
Telephone Tadley 4111, England

- (1) Facility Location-Proximity to Occupied Areas Aldermaston, Reading, Berks. England
Nearest village Aldermaston, distance ~ 0.7 miles
- (2) Purpose Development of explosive devices
Shock and detonation physics
- (3) Test Explosive Weight Limit (Equivalent Kg of TNT) 5 kg
- (4) Principal Constraints on Explosive Weight Limit Structural damage to the chamber
- (5) Type of Firing Chamber Construction (e.g., reinforced concrete) Reinforced concrete
- (6) Diagnostics in Use Pin probes, optics, flash radiography
- (7) Other Comments

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CONTAINED EXPLOSIVE FIRING FACILITIES- QUESTIONNAIRE -

Organization Bureau of Mines
Contact Richard W. Watson
(412) 892-2400 x650
Telephone (FTS) 726-2650

- (1) Facility Location-Proximity to Occupied Areas Our research facility is located in the southwest metropolitan Pittsburgh area; one of our shooting sites is located approximately 550 ft from our nearest residential neighbors.
- (2) Purpose Explosive evaluation and research
- (3) Test Explosive Weight Limit (Equivalent Kg of TNT) 5 kg upper limit; 1 kg normal charge size
- (4) Principal Constraints on Explosive Weight Limit Bombproof integrity; noise; ground vibration
- (5) Type of Firing Chamber Construction (e.g., reinforced concrete) Reinforced concrete, steel-lined closed structures
- (6) Diagnostics in Use High-speed photography, flash radiography, and electronic instrumentation
- (7) Other Comments _____

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CONTAINED EXPLOSIVE FIRING FACILITIES- QUESTIONNAIRE -

Organization E. I. du Pont
Pot. Riv. Dev. Lab.
Martinsburg, W.VA 25401

Contact F. A. Loving

Telephone 304-267-2941

(1) Facility Location-Proximity to Occupied Areas _____

on-site 20 ft

off-site 1000 ft

(2) Purpose Explosives testing

(3) Test Explosive Weight Limit (Equivalent Kg of TNT) 5 kg

(4) Principal Constraints on Explosive Weight Limit Shell strength

(5) Type of Firing Chamber Construction (e.g., reinforced concrete) _____

12 ft. diameter steel sphere, 4 1/2 ft door, c.f. U.S. pats. 3,165,916;

2,940,300

(6) Diagnostics in Use Inspection for cracks

(7) Other Comments Also, conduct underwater and earth covered tests.

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CONTAINED EXPLOSIVE FIRING FACILITIES

- QUESTIONNAIRE -

Organization	Frank J. Seiler Research Laboratory
Contact	USAF Academy, Co. Capt. R. Martin Goidry
Telephone	303-472-2655

(1) Facility Location-Proximity to Occupied Areas _____

NO FACILITY

(2) Purpose _____ N/A

(3) Test Explosive Weight Limit (Equivalent Kg of TNT) _____ N/A

(4) Principal Constraints on Explosive Weight Limit _____ N/A

(5) Type of Firing Chamber Construction (e.g., reinforced concrete) _____ N/A

(6) Diagnostics in Use _____ N/A

(7) Other Comments _____ NOT APPLICABLE

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CONTAINED EXPLOSIVE FIRING FACILITIES

- QUESTIONNAIRE -

Organization HARRY DIAMOND LABS, Branch 420

Contact R. K. Warner

Telephone (202) 394-2420

(1) Facility Location-Proximity to Occupied Areas Inside a 22' - 10" x 25' - 3"

Electromagnetically shielded room which is inside a 3,000 ft² laboratory
building. People (up to 10) in building full-time.

(2) Purpose Explosive train R/D in support of Electronic/Proximity Fuzes.

(3) Test Explosive Weight Limit (Equivalent Kg of TNT) [10 gm) Tested twice by

manufacturer - each time 12.5 gm RDX at 1 atm

(4) Principal Constraints on Explosive Weight Limit Chamber strength and initial

chamber pressure - (can evacuate to 30 μ or perhaps a bit less). Noise?

(5) Type of Firing Chamber Construction (e.g., reinforced concrete) All Steel

Cylindrical section and both semi-elliptical heads 1/2" thick. Length
overall \sim 33"; O.D. \sim 18".

(6) Diagnostics in Use Electronic: such as ion/self-shortening pins. manganin gage

(eventually). Two 5 1/2" diameter camera ports diametrically opposite.

each other (IMACON camera available).

(7) Other Comments Manufactured by Reynolds Industries, San Ramon, CA 94583

Bert MacDonald 837-0567

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CONTAINED EXPLOSIVE FIRING FACILITIES

- QUESTIONNAIRE -

Organization Harry Diamond Labs, Branch 420
Contact R. K. Warner
Telephone (202) 394-2420

- (1) Facility Location-Proximity to Occupied Areas Initially: at NSWC/WOL on or shortly after 6/24/78: James Practor (202) 394-1169/for determining (exp't'ly) safe H.E. weight. Eventually: inside a 22'-10"x25'-3" Electromagnetic shield room a 3000 ft² building (Up to 10 people in building full time).
- (2) Purpose Explosive train R/D in support of electronic/proximity fuzes.
- (3) Test Explosive Weight Limit (Equivalent Kg of TNT) Estimates range from 200 gm to 400 gm PETN (see (1) above).
- (4) Principal Constraints on Explosive Weight Limit Chamber strength and initial pressure. Will be capable of being evacuated to about 60 μ - or less. Noise?
- (5) Type of Firing Chamber Construction (e.g., reinforced concrete): All steel/quick-opening door (WSF Industries' design and fabrication). Steel wall 1 1/2" thick; semi ellip. hds. from 1 1/2" to 6" thick; length overall \sim 95 1/2", O.D. \sim 55" in cylindrical portion.
- (6) Diagnostics in Use Will be able to use electronics (pins, manganin gages, etc), will have 2 pairs of opposed camera viewpoints, ea 6" diameter.
- (7) Other Comments Being fabricated by WSF Industries, Tonawanda, NY
Cost: approximately 32.9K including vac. tests and static pressure (350 psi)

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CONTAINED EXPLOSIVE FIRING FACILITIES- QUESTIONNAIRE -Organization Hercules, Inc.Contact C. W. EiloTelephone 302-575-6118

(1) Facility Location-Proximity to Occupied Areas _____

(2) Purpose _____

(3) Test Explosive Weight Limit (Equivalent Kg of TNT) _____

(4) Principal Constraints on Explosive Weight Limit _____

(5) Type of Firing Chamber Construction (e.g., reinforced concrete) _____

(6) Diagnostics in Use _____

_____(7) Other Comments We have no contained facility

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CONTAINED EXPLOSIVE FIRING FACILITIES

- QUESTIONNAIRE -

Organization Honeywell, Inc.
Contact J.A. Pratt/J.A. FitzGerald
Telephone 612-441-1492

- (1) Facility Location-Proximity to Occupied Areas _____
Honeywell Proving Ground, Route #1, Elk River, Minnesota 55330
Approximately 3/4 mile from nearest dwelling
- (2) Purpose Measurement of H.E. devices functional properties
and effects
- (3) Test Explosive Weight Limit (Equivalent Kg of TNT) _____
11 Kilograms
- (4) Principal Constraints on Explosive Weight Limit Damage to adjacent
instrumentation building and atmospheric propagation of shock
waves.
- (5) Type of Firing Chamber Construction (e.g., reinforced concrete) _____
Adapted to test conditions. Temporary construction consisting
of steel plates, concrete, earthworks and sandbags
- (6) Diagnostics in Use Flash x-ray, Cordon and Fastax cameras, pin
switches (for denonation velocity), pressure gages
- (7) Other Comments _____

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CONTAINED EXPLOSIVE FIRING FACILITIES

- QUESTIONNAIRE -

Organization Honeywell, Inc.
Contact J.A. Pratt/J.A. FitzGerald
Telephone 612-441-1492

(1) Facility Location-Proximity to Occupied Areas _____

Honeywell Proving Ground, Route #1, Elk River, Minnesota 55330.

Approximately 1/3 mile from nearest dwelling.

(2) Purpose Pneumatic tubes used for decelerating and recovering

gun-fired 20, 25, and 30 mm high velocity projectiles

(3) Test Explosive Weight Limit (Equivalent Kg of TNT) _____

No established limit

(4) Principal Constraints on Explosive Weight Limit _____

Capacity of gun chamber used for testing

(5) Type of Firing Chamber Construction (e.g., reinforced concrete) _____

Heavy wall steel tubing

(6) Diagnostics in Use Pressure and muzzle-velocity instrumentation

(7) Other Comments _____

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CONTAINED EXPLOSIVE FIRING FACILITIES- QUESTIONNAIRE -

Organization Honeywell, Inc.
Contact J.A. Pratt/J.A. FitzGerald
Telephone 612-441-1492

- (1) Facility Location-Proximity to Occupied Areas _____
Honeywell Proving Ground, Route #1, Elk River, Minnesota 55330
Approximately 1/3 mile from nearest dwelling.
- (2) Purpose Water filled chamber used for munition testing and fragment recovery.
- (3) Test Explosive Weight Limit (Equivalent Kg of TNT) _____
3/4 Kilogram
- (4) Principal Constraints on Explosive Weight Limit _____
Structural damage to chamber walls
- (5) Type of Firing Chamber Construction (e.g., reinforced concrete) _____
Steel lined reinforced concrete
- (6) Diagnostics in Use Fragment size and mass distribution analysis
- (7) Other Comments _____

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CONTAINED EXPLOSIVE FIRING FACILITIES

- QUESTIONNAIRE -

Organization IIT Research Institute
Contact H. S. Napadensky
Telephone 312-567-4782

(1) Facility Location-Proximity to Occupied Areas _____

(2) Purpose _____

(3) Test Explosive Weight Limit (Equivalent Kg of TNT) _____

(4) Principal Constraints on Explosive Weight Limit _____

(5) Type of Firing Chamber Construction (e.g., reinforced concrete) _____

(6) Diagnostics in Use _____

(7) Other Comments We have no contained - explosive facility

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CONTAINED EXPLOSIVE FIRING FACILITIES

- QUESTIONNAIRE -

Organization LASL, M-3

Contact J. R. Travis

Telephone _____

(1) Facility Location-Proximity to Occupied Areas NONE

(2) Purpose _____

(3) Test Explosive Weight Limit (Equivalent Kg of TNT) _____

(4) Principal Constraints on Explosive Weight Limit _____

(5) Type of Firing Chamber Construction (e.g., reinforced concrete) _____

(6) Diagnostics in Use _____

(7) Other Comments _____

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CONTAINED EXPLOSIVE FIRING FACILITIES

- QUESTIONNAIRE -

Organization Group M-4, LASL

Contact R. Karpp

Telephone (505)667-5220

- (1) Facility Location-Proximity to Occupied Areas Test facilities are located in controlled access areas about one mile from Laboratory office buildings and about five miles from residential areas.
- (2) Purpose The containment facility is used for tests related to weapon studies and equation of state studies when, for purposes of safety, the explosive products and debris are to be completely contained.
- (3) Test Explosive Weight Limit (Equivalent Kg of TNT) About 25 kg of TNT
- (4) Principal Constraints on Explosive Weight Limit Strength of containment vessel
- (5) Type of Firing Chamber Construction (e.g., reinforced concrete) Spherically shaped steel containment vessel fired inside a spherically shaped steel safety vessel.
- (6) Diagnostics in Use 1. flash x ray 2. pin measurement of free-surface motion and shock-wave position. 3. quartz gauges, manganin gauges, pressure gauges.
- (7) Other Comments Please send us a copy of the results of this survey.

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CONTAINED EXPLOSIVE FIRING FACILITIES

- QUESTIONNAIRE -

Organization Monsanto Research Corporation
(Mound Laboratory)

Contact Melvin E. Babcock

Telephone (FTS) 774-7100
513-866-7444 (Ext. 7100)

- (1) Facility Location-Proximity to Occupied Areas Approximately a half mile from the City of Miamisburg, Ohio
- (2) Purpose Development and WR qualification testing of EBW detonators, pyrotechnic components, and other explosive devices.
- (3) Test Explosive Weight Limit (Equivalent Kg of TNT) By test chambers:
2 ea. 1.4 Kg; 1 ea. 0.9 Kg; 4 ea. 0.5 Kg; and 1 ea. .25 Kg.
- (4) Principal Constraints on Explosive Weight Limit Limits determined by peak pressure permissible at chamber walls.
- (5) Type of Firing Chamber Construction (e.g., reinforced concrete) .25 Kg chamber - reinforced concrete
remaining chambers - steel
- (6) Diagnostics in Use Rotating Mirror Camera; Time Interval Counters;
Oscilloscopes; Waveform Digitizing Systems.
- (7) Other Comments _____

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CONTAINED EXPLOSIVE FIRING FACILITIES

- QUESTIONNAIRE -

Organization Naval Weapons Station, Yorktown, VA

Contact L. R. Rothstein

Telephone 804-887-4762

(1) Facility Location-Proximity to Occupied Areas _____

(2) Purpose _____

(3) Test Explosive Weight Limit (Equivalent Kg of TNT) _____

(4) Principal Constraints on Explosive Weight Limit _____

(5) Type of Firing Chamber Construction (e.g., reinforced concrete) _____

(6) Diagnostics in Use _____

(7) Other Comments NWS/Y only test charges up to 1/2#. The burning ground can detonate up to 50#. Diagnostic tests are new at NSWC, Dahlgrew, VA. where extensive facilities exists.

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CONTAINED EXPLOSIVE FIRING FACILITIES- QUESTIONNAIRE -

Organization Naval Surface Weapons Center
White Oak Laboratory

Contact N. L. Coleburn

Telephone (202) 394-1189

- (1) Facility Location-Proximity to Occupied Areas 1/2-mile to residential
area; 50 yards to other Laboratory facilities
- (2) Purpose Explosives Research
- (3) Test Explosive Weight Limit (Equivalent Kg of TNT) 23 Kg
- (4) Principal Constraints on Explosive Weight Limit Facility Structure
- (5) Type of Firing Chamber Construction (e.g., reinforced concrete) Reinforced
concrete - 1-inch armor plate lined with 1-inch plywood
- (6) Diagnostics in Use Streak and Framing Cameras, Pulse X-Ray, Raster
Oscilloscope System
- (7) Other Comments There are four bombproof facilities in use at the White
Oak Laboratory. In three of these facilities the explosion products

(see reverse side)

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7. Other Comments: Continued

can be completely contained. The third facility has a 13 Kg limit. Gun-propelled fragment projectiles are fired through an opening into this facility.



DEPARTMENT OF THE NAVY
NAVAL WEAPONS CENTER
CHINA LAKE, CALIFORNIA 93555

IN REPLY REFER TO:

1 April 1977
3834/HDM:mla

Dr. Richard C. Weingart, L-24
Lawrence Livermore Laboratory
P.O. Box 808
Livermore, CA 94550

Dear Dr. Weingart:

In response to your questionnaire regarding contained explosive firing facilities; I do not have any. My firing facilities are all open pad or semi-enclosed. G. A. Greene, also at China Lake, does have an enclosed firing bay. He is on your list and will no doubt respond.

Sincerely,

H Dean Mallory

H. DEAN MALLORY
Research Chemist
Detonation Physics Division (3834)

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CONTAINED EXPLOSIVE FIRING FACILITIES

- QUESTIONNAIRE -

Organization Sandia Albuquerque, BLDG 904

Contact _____

Telephone _____

(1) Facility Location-Proximity to Occupied Areas _____

CLOSE

(2) Purpose Explosive component testing

(3) Test Explosive Weight Limit (Equivalent Kg of TNT) _____

1/2 kg

(4) Principal Constraints on Explosive Weight Limit _____

Structure

(5) Type of Firing Chamber Construction (e.g., reinforced concrete) _____

Steel

(6) Diagnostics in Use Camera, Electronics

(7) Other Comments _____

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CONTAINED EXPLOSIVE FIRING FACILITIES

- QUESTIONNAIRE -

Organization Sandia, Albuquerque, Bld. 9926

Contact Lee Davison

Telephone 505-264-7357

(1) Facility Location-Proximity to Occupied Areas _____

Remote area, but near another firing range.

Equipped with machine shot, etc.

(2) Purpose Research

(3) Test Explosive Weight Limit (Equivalent Kg of TNT) _____

2 kg

(4) Principal Constraints on Explosive Weight Limit _____

Building structure can fire large shots at adjoining outside range

(5) Type of Firing Chamber Construction (e.g., reinforced concrete) _____

Reinforced concrete

(6) Diagnostics in Use _____

Electronics, Laser Interferometers, Camera ports.

(7) Other Comments _____

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CONTAINED EXPLOSIVE FIRING FACILITIES

- QUESTIONNAIRE -

Organization Sandia Albuquerque, Bld. 9940

Contact

Telephone

(1) Facility Location-Proximity to Occupied Areas

Remote, but equipped with machine shop

(2) Purpose Explosive componenets - Development

(3) Test Explosive Weight Limit (Equivalent Kg of TNT)

1 kg

(4) Principal Constraints on Explosive Weight Limit

Structure

(5) Type of Firing Chamber Construction (e.g., reinforced concrete)

Steel Tank

(6) Diagnostics in Use Electronics, Cameras

(7) Other Comments

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CONTAINED EXPLOSIVE FIRING FACILITIES

- QUESTIONNAIRE -

Organization Sandia Albuquerque, BLDG 9990

Contact _____

Telephone _____

(1) Facility Location-Proximity to Occupied Areas _____

Remote, but extensive facilities on-site

outdoor facility in conjunction

(2) Purpose Research, testing

(3) Test Explosive Weight Limit (Equivalent Kg of TNT) _____

1/2 kg (100-300 kg outside)

(4) Principal Constraints on Explosive Weight Limit _____

Structure

(5) Type of Firing Chamber Construction (e.g., reinforced concrete) _____

Concrete

(6) Diagnostics in Use Electronics, Cameras, Flash X-ray

(7) Other Comments Has LARGE capacitor banks

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CONTAINED EXPLOSIVE FIRING FACILITIES- QUESTIONNAIRE -Organization SLL - Environmental Test Division 8413Contact Robert M. HargreavesTelephone 422-2135

- (1) Facility Location-Proximity to Occupied Areas Sandia Laboratories, Livermore, CA;
Building 973; Occupied Areas within 15 feet
- (2) Purpose Development testing of weapon components; advanced development testing of
hazardous (not necessary explosive) components/systems.
- (3) Test Explosive Weight Limit (Equivalent Kg of TNT) 2 Kg
- (4) Principal Constraints on Explosive Weight Limit Firing chamber design limits
- (5) Type of Firing Chamber Construction (e.g., reinforced concrete) Basically a
cylindrical, steel chamber, 9 feet in diameter, 22 feet long, within wall thickness
of 1 inch. Hydraulically operated doors 6 feet high and 3 feet wide.
- (6) Diagnostics in Use Oscilloscope techniques, framing and streak camera, flash
X-ray and analog tape.
- (7) Other Comments Facility diagnostics will be upgraded over the next three years to
provide an automated, direct digital recording capability which will enhance the safety
of the facility and reliability of the recoding data.

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CONTAINED EXPLOSIVE FIRING FACILITIES

- QUESTIONNAIRE -

Organization Shock Hydrodynamics

Contact Dr. Louis Zernow

Telephone 213-985-6940

(1) Facility Location-Proximity to Occupied Areas _____

Newhall, California, nearest inhabited (homes area) approximately 2 miles

(2) Purpose Explosive testing and commercial explosive forming

(3) Test Explosive Weight Limit (Equivalent Kg of TNT) _____

in air 2 kg - 5 kg underwater

(4) Principal Constraints on Explosive Weight Limit _____

Noise

(5) Type of Firing Chamber Construction (e.g., reinforced concrete) _____

SEVERAL: 1) Reinforced concrete , 2) Earth covered steel,

3) Water filled tank

(6) Diagnostics in Use 1) Flash X-ray - 5 channels, 2) High Speed Optical

25K to 10⁶ frames/sec, 3) Raster and other electronic

(7) Other Comments Would appreciate a copy of the compilation

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CONTAINED EXPLOSIVE FIRING FACILITIES- QUESTIONNAIRE -Organization Stanford Research InstituteContact William WilkinsonTelephone 415-326-6200, X-3518

(1) Facility Location-Proximity to Occupied Areas

Facility located in Menlo Park, CA in basement of a two story office building.(2) Purpose Research on explosives effects(3) Test Explosive Weight Limit (Equivalent Kg of TNT) 0.25 kg(4) Principal Constraints on Explosive Weight Limit Noise - up to 2 kg has
been fired using sand baffles.(5) Type of Firing Chamber Construction (e.g., reinforced concrete) reinforced concrete(6) Diagnostics in Use Stress gages, pressure gages, particle velocity gages,
accelerometers, strain gages, high speed cameras

(7) Other Comments

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CONTAINED EXPLOSIVE FIRING FACILITIES- QUESTIONNAIRE -Organization Systems, Science and SoftwareContact Carl PetersenTelephone 714-453-0060

(1) Facility Location-Proximity to Occupied Areas _____

1 1/2 miles to inhabited areas off-site, approximately 150 ft. to bunker(2) Purpose Special purpose - built to test decoupling with heat sink. Also,
used to maintain confined pressure for longer time.

(3) Test Explosive Weight Limit (Equivalent Kg of TNT) _____

4.5 kg - (45 kg with carbon heat sink)

(4) Principal Constraints on Explosive Weight Limit _____

Strength of vessel wall

(5) Type of Firing Chamber Construction (e.g., reinforced concrete) _____

Steel sphere - 6 ft I.D., 4" walls.(6) Diagnostics in Use Equipped with ports. Mainly has used pressure gages.(7) Other Comments Most of our work is in the open or earth-confined. We would appreciate
a compilation of the report.

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CONTAINED EXPLOSIVE FIRING FACILITIES

- QUESTIONNAIRE -

Organization TELEDYNE McCORMICK SELPH

Contact Harry Ghilarducci

Telephone (408) 637-3731 Ext. 321

(1) Facility Location-Proximity to Occupied Areas Hollister, California

3601 Union Road. Located in a rural farm area, 650 ft. from nearest county
road and 1800 ft. from nearest neighbor.

(2) Purpose Manufacture and testing of pyrotechnic and explosive devices.

(3) Test Explosive Weight Limit (Equivalent Kg of TNT) 450 grams

(4) Principal Constraints on Explosive Weight Limit _____

Construction of firing bays.

(5) Type of Firing Chamber Construction (e.g., reinforced concrete) _____

Two (2) 10' x 10' x 9' reinforced concrete firing bays.

(6) Diagnostics in Use High speed photography, electronic counters and
oscilloscopes.

(7) Other Comments Open air test bunker with 1.4 Kg explosive weight limit.

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